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Docket No.: 243905US2

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

RE: Application Serial No.: 10/682,119
Applicants: Atsuo SAKAI
Filing Date: October 10, 2003
For: STEERING CONTROL DEVICE
Group Art Unit: 3611
Examiner: Yeagley, Daniel S.

SIR:

Attached hereto for filing are the following papers:

SECOND APPEAL BRIEF UNDER 37 C.F.R. § 41.37

Our online credit card payment in the amount of **$0.00** is attached covering any required fees. In the event any variance exists between the amount enclosed and the Patent Office charges for filing the above-noted documents, including any fees required under 37 C.F.R 1.136 for any necessary Extension of Time to make the filing of the attached documents timely, please charge or credit the difference to our Deposit Account No. 15-0030. Further, if these papers are not considered timely filed, then a petition is hereby made under 37 C.F.R. 1.136 for the necessary extension of time. A duplicate copy of this sheet is enclosed.

Respectfully submitted,

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DOCKET NO: 243905US2

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF	:
ATSUO SAKAI	: EXAMINER: YEAGLEY, DANIEL S
SERIAL NO: 10/682,119	:
FILED: OCTOBER 10, 2003	: GROUP ART UNIT: 3611
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I. REAL PARTY IN INTEREST

The real party in interest is the assignee of record, TOYODA KOKI KABUSHIKI KAISHA of Kariya, Japan, now JTEKT.

II. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

III. STATUS OF CLAIMS

Claims 1-2 and 11-14 stand rejected and are being appealed. Claims 3-10 have been cancelled.

IV. STATUS OF AMENDMENTS

All amendments have been entered. It is noted that the advisory action dated October 27, 2006 indicates that the amendment filed October 5, 2006 overcomes the rejection under 35 U.S.C. § 112.

V. SUMMARY OF CLAIMED SUBJECT MATTER

In a conventional steering system the steered road wheels are mechanically connected to the steering wheel and so the driver receives feedback in the form of a reaction force mechanically transmitted from the steered road wheels. On the other hand, in a vehicle having an electric steering system it becomes necessary to provide a mechanism for simulating a reaction force to be fed to the driver.

It has been known to provide a reaction force to the driver in an electric steering system by taking into account the steering torque and a current command value I_n being provided to the vehicle wheel steering motor 6. Such a system is illustrated in Fig. 12 of the present specification. In this case, a position control portion 10A issues an output current I_n to the vehicle wheel steering motor 6 which steers the road wheels 9, based on a sensed steering angle θ and a sensed vehicle wheel position X_a. The reaction force to the driver corresponds to a signal i_n provided by a reaction force control portion 5 based upon the current I_n and a torque signal.

In order to provide a virtual contact resistance force corresponding to the contact resistance conventionally felt due to a mechanical stop at the end of rotation movement of the steering wheel shaft, the output current I_n is rapidly increased at a fixed end of movement position of the steering wheel, which also increases the reaction force current i_n. However,

since the increased end of movement reaction force current i_n results from an increased steering command current I_n which is delivered to the steering motor 6, this can result in an excessively large command value I_n being delivered to the steering motor, resulting in heat build-up or damage in the motor (page 3, lines 14-21).

According to a feature of the invention set forth in Claim 1, and referring to the non-limiting embodiments in Figs. 3 and 5, the end of movement position of the steering wheel is not fixed. Instead, a predetermined permissible range ($-\theta_E \leq \theta \leq \theta_E$) of the steering angle θ is determined based on factors including the vehicle speed v. For example, θ_E is determined at step 830 in Fig. 8 as a function of vehicle speed as shown in Fig. 9. The steering angle limits may therefore be chosen to minimize the heat build-up problem (page 14, lines 17-23).

Relating the elements of Claim 1 to the non-limiting embodiments of the figures, a steering angle sensor 2 detects a steering angle θ of the steering wheel, and a steering change amount sensor 7 outputs a steering change amount X_a to the vehicle wheel steering mechanism (page 9, line 23 – page 10, line 31; page 11, line 20 – page 12, line 2). An end-of-movement reaction force generation unit 20 or 21 generates a virtual contact resistance force that inhibits the steering angle θ from exceeding threshold values of a predetermined permissible range ($-\theta_E \leq \theta \leq \theta_E$). A steering angle threshold value variation unit 11C (Fig. 11) dynamically changes the upper limit point θ_E and the lower limit point $-\theta_E$ of the permissible range based on a vehicle speed v.

According to a further feature of the invention set forth in Claim 11, the steering actuator imparts a steering reaction force to the steering wheel based upon *the sum of* the reaction force signal from the reaction force control means and a virtual contact resistance force signal from an end of movement reaction force generation control means. For example, the reaction force motor 4 in Figs. 3 and 5 receives both a signal i_1 from the reaction force control portion 5 and another signal i_2 from the end reaction force control portion 20 (21),

which signals are summed to provide the steering reaction force (equation 1; step 850 in Fig. 8). Since signal i_2 from the end reaction force control portion can be increased to simulate an end of movement reaction force, without affecting the value of the signal I_n to the steering motor 6, heat build-up or damage in the motor 6 is avoided.

Relating the elements of Claim 11 to the non-limiting embodiments of the figures, a steering angle sensor 2 detects a steering angle θ of the steering wheel, and a steering change amount sensor 7 detects a steering change amount X_a in the vehicle wheel steering mechanism. A position control means generates a command value for the vehicle wheel steering actuator based on the detected steering change amount and the detected steering angle θ of the steering wheel. The corresponding structure in the specification is the position control portion 10B (Figs. 3 and 5). A reaction force control means generates a reaction force signal i_n to the steering wheel steering actuator based on the command value I_n. The corresponding structure in the specification is the reaction force control portion 5. An end-of-movement reaction force generation means generates, in a vicinity of an upper limit point θ_E of the steering angle θ and a vicinity of a lower limit point $-\theta_E$ of the steering angle θ, a virtual contact resistance force signal. The corresponding structure in the specification is the end-of-movement reaction force generation unit 20 (Fig. 3) or 21 (Fig. 5).

VI. <u>GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL</u>

Claims 1, 2 and 11-14 stand finally rejected under 35 U.S.C. § 102 as being anticipated by U.S. patent 5, 247,441 (<u>Serizawa et al</u>).

VII. ARGUMENT

A. Claims 1-2

Serizawa et al does not provide a steering angle threshold value variation unit that dynamically changes the upper limit point θ_E and the lower limit point $-\theta_E$ of the permissible steering range based on a vehicle speed v.

Serizawa et al is concerned with ensuring that the vehicle operator will know when the end of movement limit of the steering wheel has been reached. Accordingly, Serizawa et al. provides that the steering reaction force is sharply increased or oscillated when such end of movement has been reached. To this end, the maximum steering angle and steering reaction force are set according to steps S11-S37 in Serizawa et al.

To determine the maximum steering angle, it is first determined at step S11 (Fig. 4b) if the steering angle command value $\delta_{f(n)}$ is less than or equal to a "prescribed" maximum value δ_{flim} of the steering angle (col. 6, lines 28-34). If this is determined to be the case at step S11, the present *measured* steering angle $\theta_{H(n)}$ is substituted into θ_{Hlim} at step S26 (col. 8, lines 14-17): "Thus the largest possible value of the steering angle can be set up" (col. 8, lines 19-20). It may therefore be appreciated that "the largest possible value of the steering angle" is the *measured* value $\theta_{H(n)}$ when the steering command value exceeds a prescribed limit δ_{flim}, and is not changed based upon the vehicle speed.

Claims 1 and 2 recite a steering angle threshold value variation unit that dynamically changes the upper and lower limit points of the permissible steering range based on a vehicle speed. As explained above, the maximum value of the steering command value in Serizawa et al is a *measured* value $\theta_{H(n)}$ *and is not changed based upon the vehicle speed.* Serizawa et al thus fails to anticipate these claims.

The final Office Action nonetheless asserts that columns 5-6 of Serizawa et al teach changing the upper and lower limit points of a permissible steering range based on vehicle

speed. However, while Serizawa et al. also teaches determining the vehicle speed, there is no evidence that this vehicle speed information is used to change the upper and lower limit points of a permissible steering angular range. For example the coefficients C_0-C_2, C_C and d_I are described as corresponding to the vehicle speed (col. 5, lines 1-2; col. 6, lines 22-24). However these coefficients are only used in equations (3)-(6) and (14) to determine the yaw rate and ultimately the steering angle command value $\delta_{f(n)}$ at step S10. There is no evidence that they are used to determine the "prescribed" maximum value δ_{flim}, the measured steering angle $\theta_{H(n)}$ or the upper and lower limit points of a permissible steering range.

Appellants further note the statement on page 4 of the final Office Action that the limit points of the permissible steering range are changed in Serizawa et al. in accordance with the vehicle speed because column 8 describes "substituting a measured value of a steering angle into a variable θ_{Hlim} ... wherein the value is obtained using equations that contain a variable coefficient associated with the vehicle speed." However it is respectfully submitted that this statement is incorrect. The value substituted into θ_{Hlim} is not the steering angle command value $\delta_{f(n)}$ which "is obtained using equations that contain a variable coefficient associated with the vehicle speed." The steering angle command value $\delta_{f(n)}$ is only the commanded steering angle. Instead, the value substituted into θ_{Hlim} to determine the maximum steering angle is the *measured* steering angle $\theta_{H(n)}$ (col. 8, lines 14-17), which is *measured* and is not obtained using equations that contain a variable coefficient associated with the vehicle speed (col. 4, lines 55-56). Thus it is respectfully submitted that there is no evidence that Serizawa et al. teaches a steering angle threshold value variation unit that dynamically changes the upper limit point and the lower limit point of the permissible steering range based on a vehicle speed.

B. Claims 11-14

There is no description in Serizawa et al. of a signal actuator that imparts a steering reaction force to the steering wheel based upon the *sum* of a reaction force signal from a reaction force control means and a virtual contact resistance force signal from an end of movement reaction force generation control means.

Claim 11 recites that the steering actuator imparts a steering reaction force to the steering wheel based upon the *sum* of the reaction force signal from the reaction force control means and a virtual contact resistance force signal from an end of movement reaction force generation control means. For example, the reaction force motor 4 in Figs. 3 and 5 receives signal i_1 from the reaction force control portion 5 and signal i_2 from the end reaction force control portion 20 (21), which signals are summed to provide the steering reaction force (equation 1; step 850 in Fig. 8). Since the value of i_2 does not affect the steering motor 6, heat build-up or damage in the motor is minimized.

There is no description in Serizawa et al of an end of movement reaction force generating means which generates a virtual contact resistance force signal, wherein the signal actuator imparts a steering reaction force to the steering wheel based upon the *sum* of a reaction force signal from a reaction force control means and a virtual contact resistance force signal from an end of movement reaction force generation control means. Serizawa et al. instead only provides that the steering reaction force is sharply increased or oscillated when such end of movement has been reached, in order to inform the vehicle operator. Therefore, when the end of movement limit is recognized, a maximum steering reaction force T_{lim} is substituted into the steering reaction force T at step S30 so that the torque is sharply increased (col. 8, lines 26-35).

Thus while Serizawa et al teaches increasing the steering reaction torque at the limit of the permissible steering range, it does not suggest that this be done by imparting a steering

reaction force to the steering wheel based *on the sum of*: (1) a reaction force signal based on a signal to a vehicle wheel steering actuator, and (2) a separate virtual contact resistance force signal. Claims 11-14 therefore also define over Serizawa et al.

Appellants therefore believe that the final rejection is improper and request that it be REVERSED.

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APPENDIX OF APPEALED CLAIMS

Claim 1. A steering control device including a steering wheel steering mechanism having a steering actuator that imparts a steering reaction force to a steering wheel, and a vehicle wheel steering mechanism having a vehicle wheel steering actuator that drives a vehicle wheel steering shaft, comprising:

a steering angle sensor that detects a steering angle θ of the steering wheel; and

a steering change amount sensor that detects a steering change amount X_a in the vehicle wheel steering mechanism;

an end-of-movement reaction force generation unit that respectively generates, in a vicinity of an upper limit point θ_E of the steering angle θ and a vicinity of a lower limit point $-\theta_E$ of the steering angle θ, a virtual contact resistance force that inhibits the steering angle θ from exceeding threshold values of a predetermined permissible range ($-\theta_E \leq \theta \leq \theta_E$) of the steering angle θ, based on the steering angle θ, the steering change amount X_a or a command value X_n for the steering change amount X_a; and

a steering angle threshold value variation unit that dynamically changes the upper limit point θ_E and the lower limit point $-\theta_E$ of the permissible range ($-\theta_E \leq \theta \leq \theta_E$), based on a vehicle speed v.

Claim 2. The steering control device according to claim 1, wherein the steering wheel steering mechanism and the vehicle wheel steering mechanism are mechanically separate.

Claim 11. A steering control device including a steering wheel steering mechanism having a steering wheel steering actuator that imparts a steering reaction force to a steering wheel, and a vehicle wheel steering mechanism having a vehicle wheel steering actuator that drives a vehicle wheel steering shaft, comprising:

a steering angle sensor that detects a steering angle θ of the steering wheel; and

a steering change amount sensor that detects a steering change amount X_a in the vehicle wheel steering mechanism;

position control means for generating a command value I_n for the vehicle wheel steering actuator based on the detected steering change amount X_a and the detected steering angle θ of the steering wheel;

reaction force control means for generating a reaction force signal i_n to the steering wheel steering actuator based on the command value I_n; and

an end-of-movement reaction force generation means for generating, in a vicinity of an upper limit point θ_E of the steering angle θ and a vicinity of a lower limit point $-\theta_E$ of the steering angle θ, a virtual contact resistance force signal,

wherein the steering wheel steering actuator imparts a steering reaction force to the steering wheel based on the sum of the reaction force signal and the virtual contact resistance force signal.

Claim 12. The steering control device according to claim 11, wherein the virtual contact resistance force signal is based on the detected steering angle θ.

Claim 13. The steering control device according to claim 11, wherein the virtual contact resistance force signal is based on the detected steering change amount X_a.

Claim 14. The steering control device according to claim 11, wherein the steering wheel steering mechanism and the vehicle wheel steering mechanism are mechanically separate.

EVIDENCE APPENDIX

None.

RELATED PROCEEDINGS APPENDIX

There are no related proceedings.